

**112** to central section **111**. Cable **200** can be manufactured using processes such as extrusion processes with controlled layer thicknesses.

[0027] In cable **200**, soft layer **211** is inboard of (i.e., closer to core **202** than) stiff layer **212**. In other embodiments, the order of layers can be varied. For example, FIG. 3 shows a longitudinal cross-section view of another cable **300** with integrated strain relief according to some embodiments. Cable **300** is generally similar to cable **200** and can be an electrical cable of arbitrary length and can have, for example, a cylindrical cross section. Cable **300** can have a core **302** that includes one or more conductive wires, which may be insulated from each other. The particular number, arrangement, and gauge of the wires can be varied as desired.

[0028] Cable **300** also has an outer sleeve **304** that can be made of polymers such as a thermoplastic elastomer (TPE), a thermoplastic urethane (TPU), or a thermosetting plastic. Numerous examples of suitable polymers are known in the art. Similarly to cable **100** or cable **200**, different longitudinal sections **111**, **112**, **113** of cable **300** can have different stiffness, with central section **111** having low stiffness, end sections **112** having high stiffness, and sections **113** having a variable stiffness that gradually transitions between the high stiffness of end section **112** and the low stiffness of central section **111**.

[0029] In cable **300**, the regions of different stiffness are created by forming outer sleeve **304** from two layers of material having different stiffness, similarly to cable **200** except that the order of layers is reversed. For example, outer sleeve **304** can be a multi-layered sleeve that includes two layers: an outer soft layer **311** made of a material that is relatively flexible (small minimum bend radius) and an inner stiff layer **312** made of a material that has a structural rigidity that is greater than that of soft layer **311** (high minimum bend radius). In some embodiments, the relative thickness of stiff layer **312** and soft layer **311** can be modified to create three regions of sleeve **304**: a stiff end section **112**, a flexible central section **111**, and a transition section **113**. As shown, in end section **112**, stiff layer **312** is thicker than soft layer **311**, so that end section **112** can be substantially rigid to resist bending of cable **300**. In central section **111**, soft layer **311** is thicker than stiff layer **312**, so that central section **111** can be substantially flexible to allow bending of cable **300**. Transition section **113** can be a region of cable **300** where stiff and soft layers **312** and **311** gradually vary in relative thicknesses between stiff end section **112** and flexible central section **111**. The total thickness of stiff layer **312** and soft layer **311** can be constant along the length of cable **300**, so that when stiff layer **312** increases in thickness, soft layer **311** decreases in thickness, and vice versa. Thus, within transition section **113**, the thickness of stiff layer **312** decreases from end section **112** to central section **111** while the thickness of soft layer **311** increases from end section **112** to central section **111**. Cable **300** can be manufactured using processes such as extrusion processes with controlled layer thicknesses.

[0030] In some embodiments, the length of end section **112** and transition section **113** of a cable such as cable **100**, cable **200**, or cable **300** can be tailored to achieve a certain bend radius to mitigate strain of the cable. For example, for a USB cable, each end section **112** can be about 2 cm long, and each transition section **113** can have the same length or a similar length, while central section **111** can extend the rest

of the length of the cable. The total length of the cable can be as long as desired. In some embodiments, cable manufacturing can include extruding a cable with alternating stiff sections having a first length (e.g., 5 cm) and flexible sections having a second length (e.g., 0.5 m to 2 m), with transition sections between each stiff section and flexible section. The cable can be cut in the middle of the stiff sections to produce lengths of cable with stiff end sections and flexible center sections. In other embodiments, a stiff section may be provided at only one end of a cable, or a stiff section may be provided somewhere along the length of the cable away from the end in addition to or instead of at one or both ends.

[0031] In some embodiments, cables such as cable **100**, cable **200**, or cable **300** can be used to provide strain relief without an increase in cable thickness. FIG. 4 shows a simplified example of an assembly **401** according to some embodiments. Cable **400** has one end captively coupled to an electronic device **420**. Electronic device **420** can be, for example, an active electronic device such as a wireless charging puck for a portable electronic device. One end **430** of cable **400** is inserted through the housing of electronic device **420** so that individual wires of cable **400** can be connected to components inside electronic device **420**. In some embodiments, the other end **435** of cable **400** can be connected to a connector **440** such as a USB connector (e.g., a Type A USB connector or USB-C connector). Those skilled in the art will be familiar with techniques for electrically connecting cables, and a detailed description is omitted. Those skilled in the art will also appreciate that it may be desirable to provide strain relief at ends **430** and **435** of cable **400**.

[0032] According to some embodiments, strain relief can be provided by using a cable **400** whose sleeve has a stiff end section as described above disposed at ends **430** and **435**. For instance, cable **400** can be an implementation of cable **100** of FIG. 1 or cable **200** of FIG. 2 or cable **300** of FIG. 3, with a stiff end section **112** disposed abutting end **410**, a flexible central section **111**, and a transition section **113** of varying stiffness between stiff end section **112** and flexible central section **111**. Similarly, at the other end **435** of cable **400**, a stiff end section **112** can be disposed abutting connector **440** to provide strain relief at that end of the cable, with another transition section **113** of varying stiffness between stiff end section **112** and flexible central section **111**. While dashed lines are used in FIG. 4 to indicate regions **111**, **112**, **113**, it should be understood that these regions need not be visually distinct, and the appearance of cable **400** may be uniform along its entire length.

[0033] In this example, electronic device **420** has a height ("z"), and it may be desirable to minimize the height z. Integrating strain relief into the cable sleeve can help to accomplish this goal.

[0034] By way of comparison, FIG. 5 shows a simplified cross-section view of an assembly **501** using a conventional strain relief technique. Cable **500** has a core **502** and an outer pliant sleeve **504**. One end **530** of cable **500** is captively coupled to an electronic device **520**, similarly to the arrangement described above with reference to FIG. 4. As shown, the end of core **502** (or individual wires thereof) can extend through the housing and into the interior of electronic device **520** while the end of sleeve **504** abuts the surface of electronic device **520**. Sleeve **504** is made of a flexible material that allows cable **500** to bend. Strain relief is